Modeling cardiac rhythm and heart rate using BFO and DOLCE

Lynda Temal, Arnaud Rosier, Olivier Dameron, Anita Burgun
U936 INSERM University of Rennes 1, IFR140, Rennes, France.

Context

• **ICD** (Implantable cardiac devices), such as artificial pacemakers or implantable cardioverter-defibrillators, **manage cardiac rhythm disorders** called arrhythmias (bradycardias, tachycardias).

• ICD send **many remote alerts** about arrhythmias to physicians.

• Physicians have to **assess the relevance** of a given alert and its **emergency level according to patient history**.

Objectives

• **Improve** alert management
• Shift *from* strictly **device-centered** follow-up *to* **patient-centered**

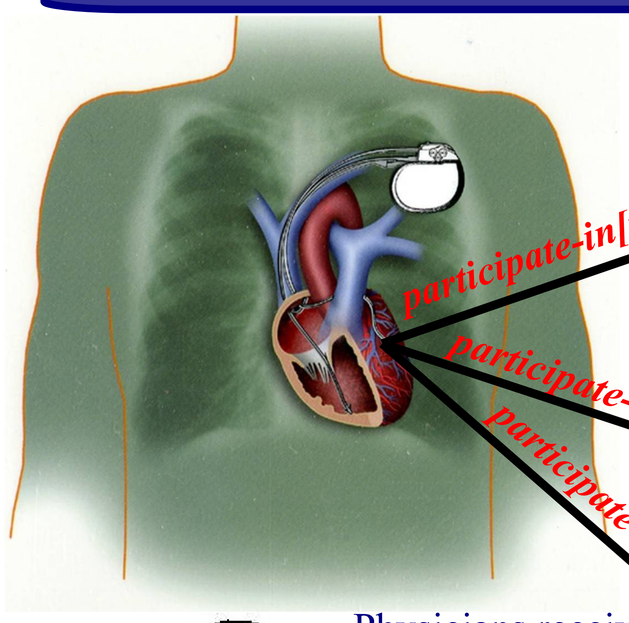
→ reasoning capabilities & domain knowledge
→ **Design of an application ontology**
according to the two following principles:
1. Application purpose
2.Use of foundational ontologies (BFO, DOLCE)

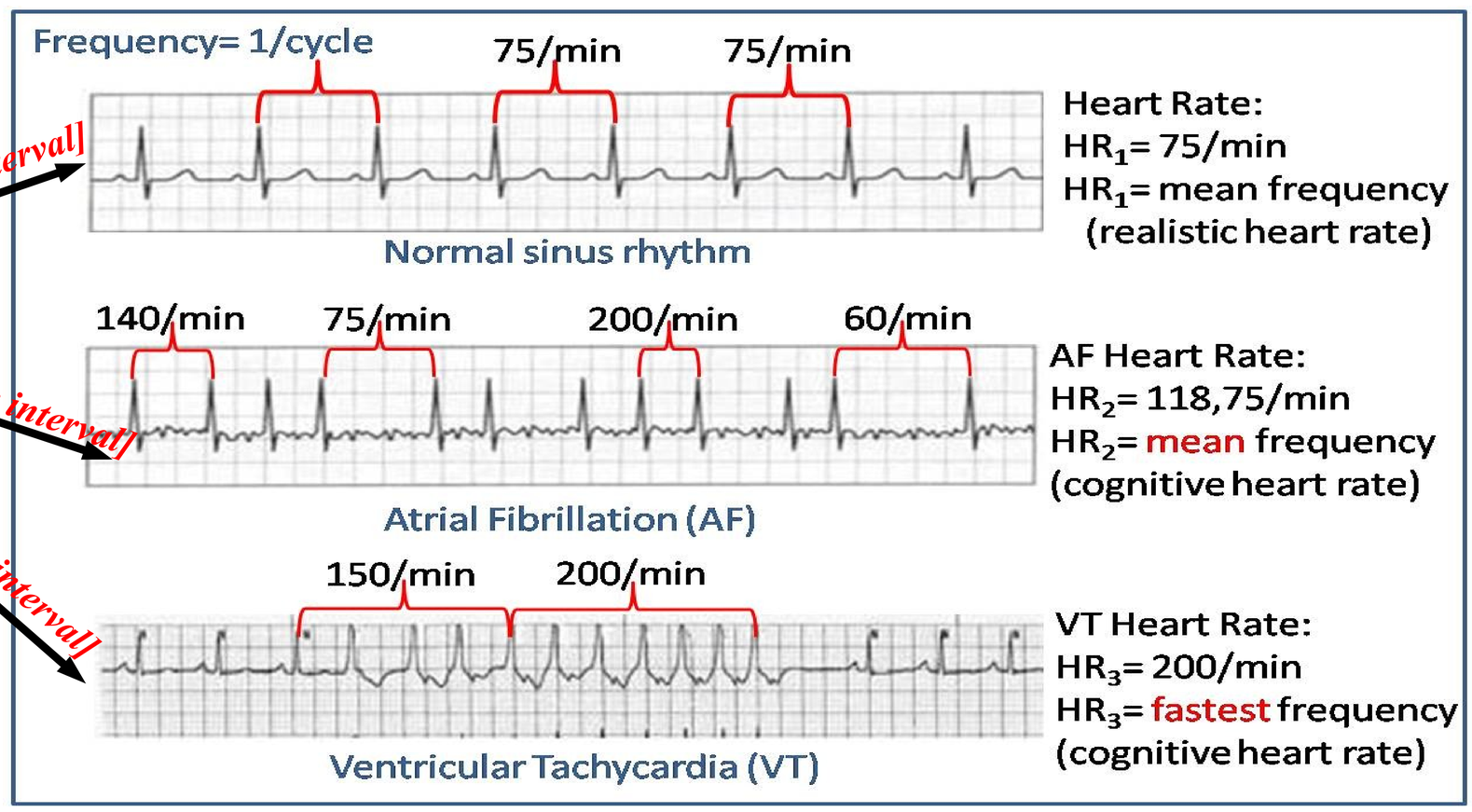
Resources

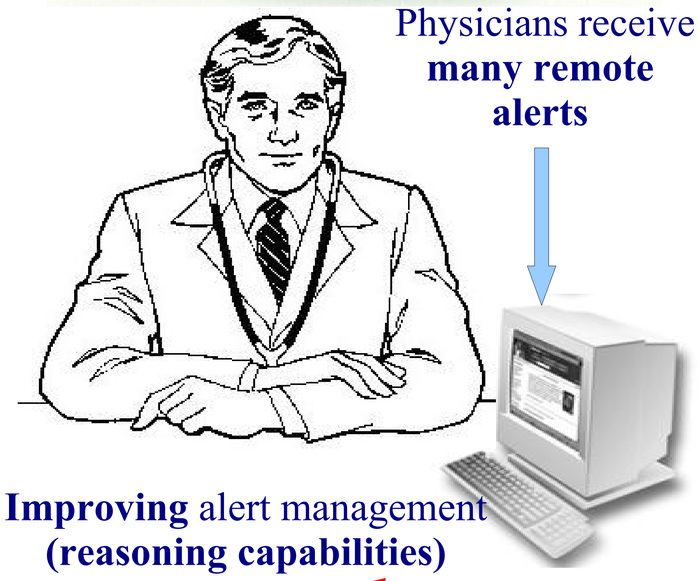
• **BFO** [2] (Basic Formal Ontology), ***realist* approach**.

• **DOLCE** [1] (Descriptive Ontology for Linguistic and Cognitive Engineering) with ***cognitive bias***.

Results: Use case & Ontology







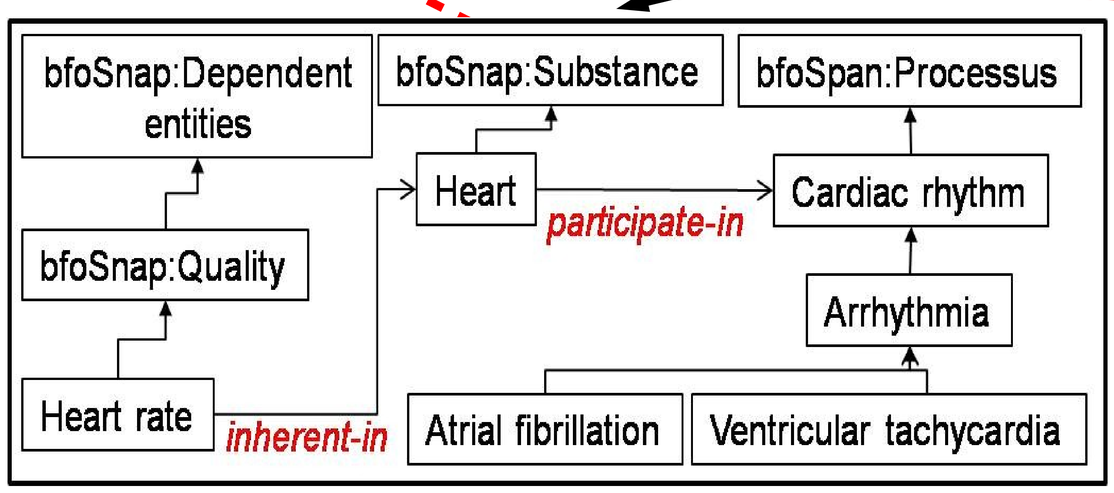
Physicians receive **many remote alerts**

Physicians **assess** a patient **risk level**

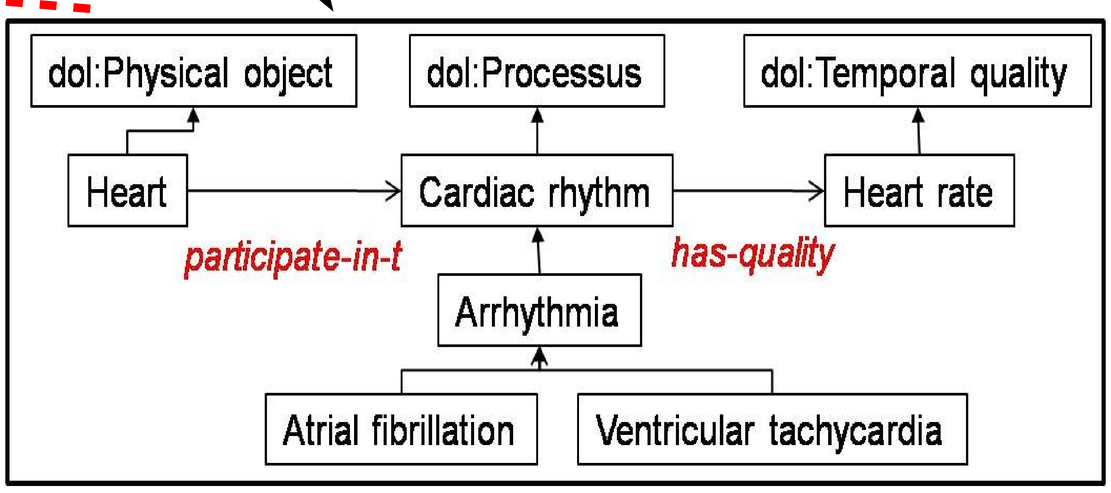
Improving alert management **(reasoning capabilities)**

Knowledge about (**designing an application ontology**)

- The **kind of Arrhythmia** (AF, VT)
- The **Heart rate** associated
- The patient clinical context



Modeling cardiac rhythm and heart rate in BFO



Modeling cardiac rhythm and heart rate in DOLCE

Discussion & Conclusion

DOLCE, with its cognitive bias, is more adapted than BFO to our telecardiology application requirements

Reasoning case: *When* **Heart rate** is fast (slow) *then* **Arrhythmia** is fast (slow)

BFO
• No qualities for perdurants (*realist* approach).

• Classification of **Arrhythmia** (as fast or slow) according to the **Heart rate** (fast or slow) is **not direct**.

• **Not suitable** to associate the **exact semantic** of the **Heart rate** according to the kind of **Arrhythmia** (mean frequency for AF, fastest frequency for VT).

DOLCE
• Perdurants can have qualities (*cognitive bias*).

• Classification of **Arrhythmia** (as fast or slow) according to the **Heart rate** (fast or slow) is **direct.**

• **Suitable** to associate the **exact semantic** of the **Heart rate** according to the kind of **Arrhythmia** (mean frequency for AF, fastest frequency for VT).

References :
[1] Grenon P. Smith B. SNAP and SPAN: prolegomenon to geodynamic ontology. In Special. Cognitive & Computer, 2004.
[2] Masolo C. Borgo S. Gangemi A. Guarino N. Oltamari A. WonderWeb Deliverable D18 Ontology Library (final). Technical report, ISTC-CNR , 2003.

Nature Precedings : doi:10.1038/npre.2009.3568.1 : Posted 6 Aug 2009